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FINAL REPORT

20040419

EFFECTS OF CATTLE COAT COLOR AND THE MC1R GENOTYPE ON RATE OF GAIN

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Program title:

Appetite Effects Associated with Cattle Coat Color
Project # 20040419

Prinicipal Investigator: Sheila Schmutz

Executive Summary

The objective of this study was to determine the effects of *MC1R* genotype and coat color on growth rates during the feeding to finish period and on carcass traits. Kim McLean, a M.Sc. student genotyped 818 steers on three different feeding regimes. Detailed analysis of one group of 329 steers which included a good representation of several genotypes demonstrated that the to E^D/E^D black cattle grew faster and deposited more backfat than either the E^D/e black cattle or *e/e* red cattle.

General objectives:

This project focused on the melanocortin receptor 1 (MC1R) genotype in cattle and the effects it showed on production traits in a pilot study. We attempted to determine if there are effects on carcass traits caused by the MC1R genotype of beef cattle.

Deviation from Workplan:

no major deviation

Background

Four of the five major beef breeds in North America are red or black. Considerable debate has existed as to which color cattle produces the highest quality meat with the least cost. Some beef marketing programs, such as "Certified Angus Beef", paid a premium price based on black coat color. Is there a justification for this based on the biology of pigmentation differences between such black and red cattle? There are also recent suggestions of weight gain differences among humans associated with different genotypes of the melanocortin receptors and/or POMC.

As in several other mammalian species a premature stop codon in *MC1R* causes cattle to be red when homozygous (e/e). The wild type allele E^+ is rare in North American beef breeds, although relatively common in some European breeds. There is a third allele, E^D, (L99P), which is typically present in black cattle.

Because MSH is involved in the pigmentation and appetite pathway, we postulated that cattle with an E^D allele would bind a smaller proportion of this hormone to MC4R in the appetite pathway than those with an *e* allele. Therefore cattle with an E^D allele would have increased appetite and gain weight more rapidly.

Results

Eight hundred and eighteen commercial feedlot steers were housed at the University of Saskatchewan Feedlot over the course of two years. These animals were used for additional feeding trials and were selected for those trials on different criteria. Two groups were a "rainbow" mix of predominantly red or red white face calves. Another group was selected with a large majority of black calves because this was stated as a preference in the protocol of that feeding trial.

Blood was collected to extract DNA from the individual animals. *MC1R* alleles were determined through two PCR-RFLP tests. The first test was to determine if there was an *e* allele present. For those animals with the *e/e* genotype the second test was not necessary to correctly genotype the animal. For those cattle with only one or no *e* allele, a second test was conducted to determine if the alleles were E^D or E^+.

Statistical analysis using ANOVA was conducted which indicated there were significant effects of the various diets among the 900 cattle. Unfortunately the cattle from two of the trials trials, one in 2003-2004 called the "Rainbows" and another in 2004-2005 called "Grant's" did not have a sufficient spread of genotypes to conduct further analysis on differences in growth and carcass traits (Table 1). The number of cattle with an E^+/E^{++} genotype was too small to determine the effects of this allele in any of the groups studied (Table 1).

Table 1. Number of steers of each genotype among the three groups of cattle studied.

Genotype	**2003-2004 "PoundMaker"**	**2003-2004 "Rainbows"**	**2004-2005 "Grant's"**
E^D/E^D	79	3	26
E^D/E^+	21	0	4
E^D/e	178	14	41
E^+/E^+	0	0	0
E^+/e	14	27	16
e/e	42	207	146
Total	**334**	**251**	**233**

The 2003-2004 PoundMaker group consisted of 329 genotyped beef steers fed either a traditional rolled or pelleted barley diet from weaning to slaughter at the U of S feedlot over the winter. Regression analysis was conducted based on the number of E^D alleles using the statistical analysis program, STATVIEW. There were no significant effects of diet on growth traits pre-slaughter for the cattle fed in 2003-2004. The data are presented in Table 2.

Table 2. Cattle fed either a rolled or pelleted diet (329 cattle)

Trait	Regression Coefficient	Probability	Difference between E^D/E^D and *e/e*
Weaning Weight	0.139	0.011	11 lb heavier
End of Backgrounding Wt (57 days on feed)	0.126	0.022	26 lb heavier
Finish Weight (141 days on feed)	0.112	0.044	31 lb heavier

However for Carcass Backfat and Rib Eye Area, the effects of the two diets were significant and so the groups of cattle were analyzed separately. Rib Eye Area (Table 3 & 4) in cattle on both diets appeared to be increased, with significant differences for the cattle fed the rolled diet and differences which approached significance for the pelleted diet. Neither group showed differences in Carcass Backfat based on the number of E^D alleles.

Table 2. Cattle fed a Rolled Diet (162 cattle)

Trait	Regression Coefficient	Probability	Difference between E^D/E^D and *e/e*
Carcass Backfat	0.227	0.004	1.5 mm more
Rib Eye Area	0.150	0.057	~5cm^2 smaller

Table 3. Cattle fed a Pelleted Diet (172 cattle)

Trait	Regression Coefficient	Probability	Difference between E^D/E^D and *e/e*
Carcass Backfat	0.23	0.77	-
Rib Eye Area	0.150	0.05	~6cm^2 smaller

The increased backfat would equate to E^D/E^D cattle spending about 23 days less in the feedlot than *e/e* cattle. Although steaks were somewhat smaller in E^D/E^D cattle, the amount of marbling was not different from the *e/e* cattle. This was confirmed using the 37 cattle for which carcass dissection data and genotype were available from the PoundMaker 2003-2004 group. Intermuscular fat differences were not significant (P = 0.58). However %Lean was significantly differerent (r= 0.385, P = 0.02) with *e/e* cattle having the highest amount.

These data suggest that production of cattle can be improved through selection by *MC1R* genotype, resulting in increased profits to ranchers. Furthermore niche marketing programs selecting for lean versus more highly fattened cattle could take advantage of coat color in purchase and advertising.

Outputs:

i) Public property:

Scientific publications:

Published or Accepted:

(amanuscript is in preparation for submission by Christmas, 2005)

Conference Presentations:

McLean, KL, Schmutz, SM. September, 2005. The effect of *MC1R* on growth and carcass traits in beef cattle. International Pigment Cell Conference, Reston, Virginia.

ii) Commercializable property:

The DNA test protocols for MC1R genotyping have been in the public domain since they were published by Klungland et al. in 2000. The test has been offered by several DNA genotyping services for several years. Although it might be possible to file an "application" patent, this would be very difficult to defend and we have been advised not to proceed.

Staffing statement:

Personnel	**Category**	**Person-Months**	
		Spent	**ADF paid**
Tom Berryere	Research Assistant	2.5	2.5
Kim McLean	M.Sc. Student	9	9
S. M. Schmutz, Ph.D.	Scientific Coordinator	2	0